REVIEW DRAFT

EVALUATION METHODOLOGY FOR THE WATER QUALITY IMPROVEMENT STRATEGIES FOR THE EVERGLADES

August 31, 2001

South Florida Water Management District
West Palm Beach, Florida

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Environmental Engineering Section
Everglades Construction Project
South Florida Water Management District

Please direct comments and questions to Gary Goforth (561) 682-6280 or Tracey Piccone (561) 682-6495

EVALUATION METHODOLOGY
FOR THE WATER QUALITY IMPROVEMENT STRATEGIES FOR THE EVERGLADES

EXECUTIVE SUMMARY

Florida's 1994 Everglades Forever Act (Act) establishes both interim and long-term water quality goals to achieve restoration and protection of the Everglades Protection Area (EPA). The South Florida Water Management District (District), in partnership with other agencies and private landowners, is aggressively and successfully achieving these interim milestones. Basin-specific feasibility studies will evaluate alternative combinations of private works and public works to achieve compliance with the long-term water quality standards for the Everglades Protection Area. Based on guidance provided by the 1994 Everglades Forever Act, the 2000 Water Resource Development Act, and relevant Florida Statutes, a methodology is proposed to evaluate these alternatives. The proposed methodology also includes recommended evaluation criteria, addressing technical performance, environmental factors, economic considerations and integration with the Comprehensive Everglades Restoration Plan (CERP).

This evaluation of alternative water quality improvement strategies is a fact-gathering activity, and by itself cannot determine or recommend an "optimal" combination of water quality treatment solutions. However, the results of the evaluation will give the Legislature, the District Governing Board, and other stakeholders the critical technical information necessary for the policy decisions needed to determine the "optimal" combination of water quality treatment solutions. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights.

1.0 INTRODUCTION

Florida's 1994 Everglades Forever Act (Act) establishes both interim and long-term water quality goals to achieve restoration and protection of the Everglades Protection Area (EPA; see Figure 1). The District, in partnership with other agencies and private landowners, is aggressively and successfully achieving these interim milestones. The District has constructed four Stormwater Treatment Areas (STAs) totaling almost 20,000 acres, and has just begun construction of the largest one, STA-3/4, with more than 17,000 acres. In addition, the Corps of Engineers is constructing the 5,500-acre STA-1 East. The STAs, coupled with on-farm Best Management Practices (BMPs) are designed to reduce the total phosphorus (TP) concentration in runoff from approximately 150 ppb to an interim target of 50 ppb. EAA landowners have implemented BMPs that have reduced phosphorus loads by more than 50% over the last six years. Concurrent with implementation of the Everglades Construction Project (ECP), the District is

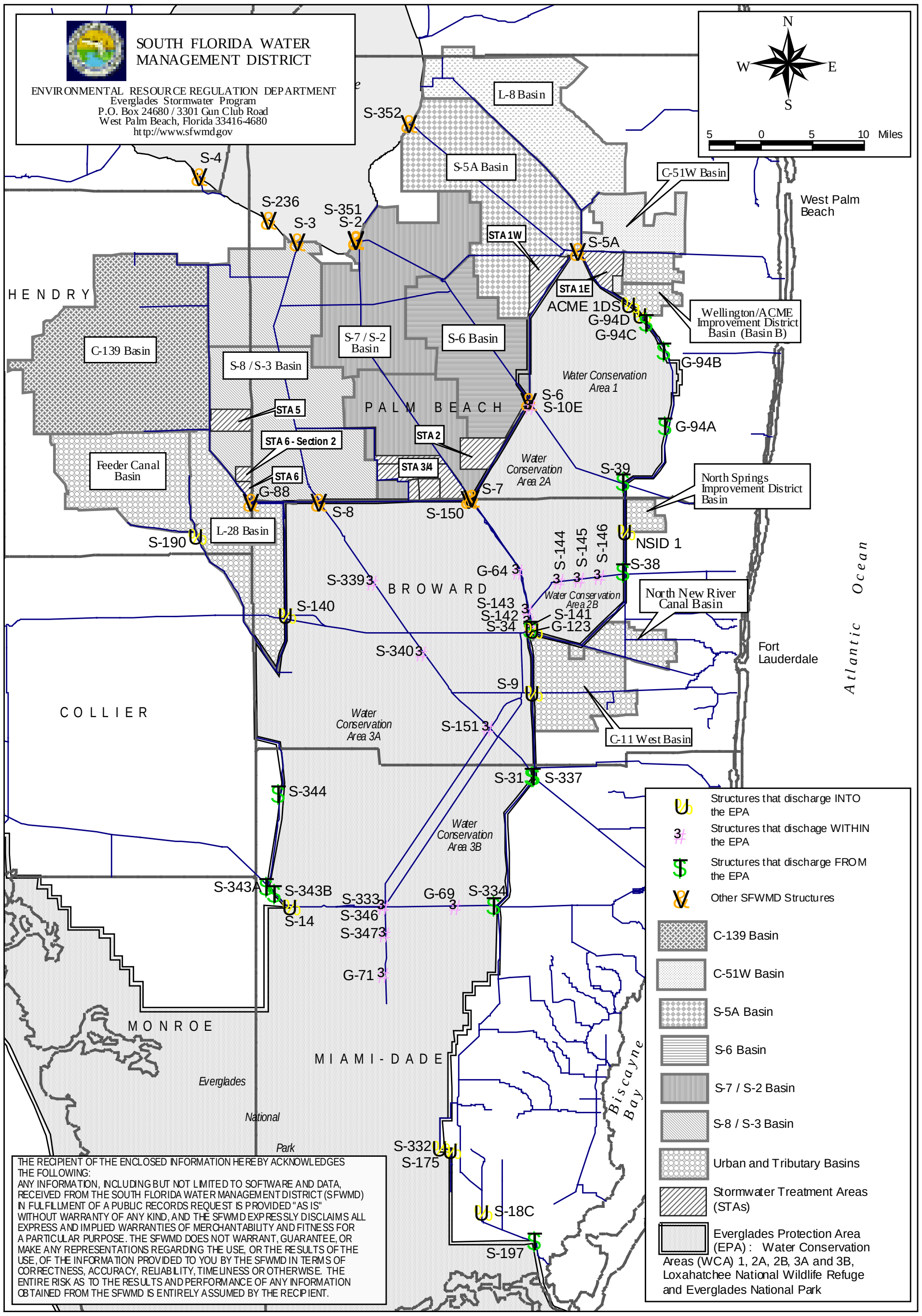

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Figure 1. Overview of the Everglades Protection Area.

implementing the Everglades Stormwater Program (ESP) to address the water quality issues associated with discharges from the remaining non-ECP Everglades tributary basins. Also concurrent with these activities, the District and other groups are conducting water quality research and ecosystem-wide planning, and implementing regulatory programs to ensure a sound scientific foundation for decision-making.

The long-term Everglades water quality objective is to implement the optimal combination of source controls, STAs, Advanced Treatment Technologies (ATTs), and/or regulatory programs to ensure that all waters discharged to the Everglades Protection Area (EPA) achieve water quality goals by December 31, 2006. Permit applications and integrated water quality plans are to be submitted to the Florida Department of Environmental Protection (FDEP) by December 31, 2003. To meet these objectives and time frames, the District is conducting basin-specific feasibility studies that will integrate information from research, regulation, and planning studies to provide information necessary to allow policy makers to determine the optimal combination of source controls and basin-scale treatment to meet the final water quality objectives.

The Everglades Forever Act mandated that additional treatment strategies be considered to reduce phosphorus levels to achieve the as-yet-undetermined numeric phosphorus standard. Advanced treatment technology research efforts are currently underway to determine the phosphorus removal capabilities of nine technologies:

1. Chemical Treatment - Direct Filtration
2. Chemical Treatment - High Rate Sedimentation
3. Chemical Treatment - Dissolved Air Floatation
4. Chemical Treatment – Microfiltration
5. Low Intensity Chemical Dosing of Wetlands
6. Managed Wetlands
7. Submerged Aquatic Vegetation (SAV) - Limestone Treatment
8. Periphyton Stormwater Treatment Areas (PSTAs)
9. Wetlands (STAs)

Currently, the remaining viable candidates include Chemical Treatment - High Rate Sedimentation, Chemical Treatment – Microfiltration, Submerged Aquatic Vegetation (SAV), Periphyton Stormwater Treatment Areas (PSTAs), and STAs. For the chemical treatment alternatives, a post-treatment polishing cell was recommended to ensure the treated waters are compatible with the receiving waters. Research is continuing to better refine the engineering, economic and phosphorus reduction characteristics of these candidates. Results from the research, which are presented in demonstration project final reports using a standardized format, are intended to be incorporated into this evaluation methodology.

2.0 OVERVIEW OF THE BASIN-SPECIFIC FEASIBILITY STUDIES

2.1 Scope

The goal of the basin-specific feasibility studies is to integrate research, planning and other available information into viable **water quality improvement strategies** to ensure that all waters discharged into the EPA achieve water quality goals. Of the sixteen basins that discharge into the EPA, the basin-specific feasibility studies will identify and evaluate alternative combinations of source control and basin-scale treatment for fourteen hydrologic basins – eight basins covered by the Everglades Construction Project (ECP) and six basins covered by the Everglades Stormwater Program (ESP). The remaining two ESP basins (C-111 Basin and Boynton Farms Basin) will be addressed through other District and Federal programs. A summary of the basins covered in the basin-specific feasibility studies is presented in Table 1.

2.2 Baseline Data

Baseline flows and phosphorus data sets have been developed by the District for thirteen basins to be evaluated by the basin-specific feasibility studies (Goforth and Piccone, 2001). A 31-year data set consisting of daily flow and phosphorus concentrations was developed for each basin and is summarized in Table 2. The baseline data set combined simulated flow values from the South Florida Water Management Model (SFWMM) for the period 1965-95 with historic phosphorus concentrations developed from water years 1990-1999.

Table 1. Everglades Protection Area Tributary Basins Included in the Basin-Specific Feasibility Studies

Basin	Canal	STA	Receiving Water
S-5A	West Palm Beach Canal	STA-1E, STA-1W, STA-2	WCA 1
S-6	Hillsboro Canal	STA-2	WCA 2A
S-7	North New River Canal	STA-3/4	WCA 2A, WCA 3A
S-8	Miami Canal	STA-3/4, STA-6	WCA 2A, WCA 3A
C-139	L-1, L-2, L-3	STA-3/4, STA-5, STA-6	WCA 2A, WCA 3A
C-139 Annex	L-28	STA-6	WCA 3A
C-51 West	C-51 West Canal	STA-1E, STA-1W	WCA 1
L-8 Basin	L-8 Borrow Canal, C-51 West Canal	STA-1E, STA-1W	Lake Okeechobee, WCA 1, Lake Worth Lagoon
North Springs Improv. District	N/A	N/A	WCA 2A
North New River Canal	North New River Canal	N/A	WCA 3A
C-11 West	C-11 West	N/A	WCA 3A
Feeder Canal	L-28 Interceptor Canal	N/A	WCA 3A
L-28	L-28 Canal	N/A	WCA 3A
ACME Basin B	L-40	N/A	WCA 1

Table 2. Summary of Simulated Baseline Flows and Phosphorus (1965-1995)

Basin / STA	Mean Annual STA Inflow (acre-feet)	STA Inflow Phosphorus (parts per billion)	Mean Annual Phosphorus Load (kg)	Mean Annual Discharge to EPA (acre-feet)	Discharge Phosphorus (parts per billion)	Mean Annual Phosphorus Load (kg)
C-51 West / STA-1 East	133,331	176	28,950	136,406	50	8,406
S-5A / STA-1 West	160,335	139	27,399	161,902	34	6,815
S-6 / STA-2	233,473	100	28,831	229,273	48	13,492
S-7, S-8 / STA-3/4	660,889	88	72,019	637,901	49	38,650
C-139 / STA-5	85,637	167	17,634	83,776	38	3,938
EAA, C-139 Annex / STA-6 (Sections 1 and 2)	80,532	121	12,050	74,930	34	3,104
Acme Basin B	N/A	N/A	N/A	31,499	94	3,660
North Springs Improvement District	N/A	N/A	N/A	6,168	39	293
N. New River Canal Basin	N/A	N/A	N/A	1,781	18	40
C-11 West Basin	N/A	N/A	N/A	194,167	17	4,063
L-28 Basin	N/A	N/A	N/A	83,806	39	3,982
Feeder Canal Basin	N/A	N/A	N/A	77,179	156	14,854

Reference: Goforth and Piccone, 2001

2.3 CERP Projects

The majority of Everglades tributary basins covered in the feasibility studies contain components of the Comprehensive Everglades Restoration Plan (CERP). These projects, summarized in Table 3, will significantly influence baseline flows and water quality characteristics. An opportunity exists for tremendous cost savings by integrating the long-term water quality solutions with the CERP components.

2.4 Remaining Work

The three remaining steps in the basin-specific feasibility studies include:

1. Develop the evaluation methodology based on the criteria established in the 1994 Everglades Forever Act, and other appropriate considerations.
2. Develop basin-specific alternative combinations of water quality solutions (e.g., source control, STA optimization, and Advanced Treatment Technologies).
3. Evaluate the alternatives.

It is anticipated that once the alternatives are evaluated and sufficient funds are appropriated, individual **water quality improvement strategies** will be finalized for each basin, and subsequent design and construction will proceed.

Table 3. CERP Projects Within Everglades Tributary Basins to be Addressed in the Water Quality Feasibility Studies

CERP Project	Compl. Date	STA -1E	STA -1W	STA -2	STA -3/4	STA -5	STA -6	ACME “B”	NNRC	NSID	C-11W	L-28	Feeder Canal
S-9A Seepage Pump & S-381 Divide Structure (A5.5.5)	*3/31/02 11/15/02*										✔		
ACME Basin “B” (A6.3.3.6)	4/25/07							✔					
Rotenberger WMA Operations (EE5)	5/3/06				✔	✔	✔						
Site 1 Impoundment (M6)	**10/24/07**									✔			
C-11 Impound. & STA (Q5)	**1/25/06**										✔		
Miccosukee WMA (A5.5.26 & A6.3.4.6)	*2008* ?											✔	
Seminole Water Conserv. Plan (A5.5.6 & A6.3.4.1)	*2008* ?												✔
Holey Land WMA Operations (DD)	3/26/08				✔	✔							
Pump Station G-404 Modification (II3)	9/24/08				✔		✔						
North New River Canal Improvements (SS4)	**10/22/08**			✔	✔				✔				
EAA Reservoir Ph. I (G6)	**9/16/09**			✔	✔	✔	✔						
WCA 3A/3B Levee Seepage Management (O)	**10/22/08**										✔		

CERP Project	Compl. Date	STA -1E	STA -1W	STA -2	STA -3/4	STA -5	STA -6	ACME "B"	NNRC	NSID	C-11W	L-28	Feeder Canal
Decompartmentalization of WCA-3 (QQ6)	10/4/10			✔	✔		✔						
L-8 Basin (K Ph 1)	3/18/11	✔	✔										
C-51 & Southern L-8 Reservoir (GGG6)	3/14/14	✔	✔										
Site 1 ASR (M6)	3/17/17									✔			
Miccosukee STA (CCC6)	6/16/15											✔	
Seminole STA (CCC6)	6/16/15											✔	✔
WCA-2 and WCA-3 Diversion Structures (YY4)	6/11/18								✔				
L-8 Basin ASR (K Ph 2)	10/18/18	✔	✔										
C-51 Regional ASR (LL)	10/15/20	✔	✔										
Everglades Rain-driven Operations (H6)	?			✔	✔		✔						

Notes:
1. CERP Projects in Bold were included in the initial project authorization in WRDA 2000.
2. Critical Restoration Projects are shown in italics and are followed by an ID number beginning with "A5".
3. Other Project Element components have an ID number beginning with "A6".
4. Completion dates taken from 7/27/2001 Update to CERP Master Implementation

3.0 EVALUATION METHODOLOGY

The proposed methodology to evaluate alternative water quality measures in each basin will be refined with stakeholder input and will be independently peer-reviewed. The proposed evaluation methodology consists of the following two components:

1. Establish the evaluation criteria
2. Establish the method by which the alternatives will be evaluated

3.1 Basis for the Evaluation Criteria

The overall goals of Everglades restoration are to improve water quality; improve the quantity, distribution, and timing of water; and to control the spread of exotic species. **The following section describes the goals and objectives specific to improving water quality.** The Comprehensive Everglades Restoration Plan is the primary mechanism for improving the quantity, distribution and timing of water, while a coordinated State and Federal program is addressing the control of exotic species.

3.1.1 Everglades Water Quality Improvement Goal

The 1994 Everglades Forever Act, the 2000 Water Resources Development Act (WRDA), and the 1992 Federal Everglades Consent Decree (amended 2001) describe the general water quality goal of Everglades restoration as implementation of comprehensive and innovative solutions to restore and protect the Everglades ecosystem while maintaining the quality of life for all residents of South Florida, including those in agriculture. These solutions shall **improve water quality**, such that all waters delivered to the Everglades Protection Area achieve and maintain compliance with state water quality standards.

3.1.2 Everglades Water Quality Improvement Objectives

Specific objectives were enumerated by the 1994 Everglades Forever Act to achieve the Everglades Water Quality Improvement Goal.

1. The Florida Department of Environmental Protection (FDEP) shall evaluate existing water quality standards applicable to the EPA and the EAA canals.
2. By December 31, 2003, the FDEP shall adopt the numeric phosphorus criterion or the default shall be 10 ppb. In addition, the FDEP shall establish the method for determining compliance with the phosphorus standard, including monitoring locations and frequency of sampling.
3. The FDEP shall establish discharge limits necessary to prevent an imbalance in the natural populations of aquatic flora or fauna in the EPA, and to provide a net improvement in the areas already impacted.
4. **By 12/31/03, the District shall submit permit modifications containing plans for achieving and maintaining compliance with State water quality**

standards, including phosphorus. The permit application shall include proposed cost estimates, proposed funding mechanisms, and proposed implementation schedules. *Collectively, these are called the Water Quality Improvement Strategies.*

5. **By 12/31/06, the Department and District shall take such actions as may be necessary so that water delivered to the EPA achieves State water quality standards, including the phosphorus criterion, in all parts of the EPA.**

This evaluation methodology has been developed to assist in achieving objectives 4 and 5.

<u>3.1.3 The 1994 Everglades Forever Act</u>

The 1994 Everglades Forever Act (ss. 373.4592, Florida Statutes) provides fundamental guidance on the criteria to be considered in evaluating alternative technologies:

> *2. The Legislature recognizes that technological advances may occur during the construction of the Everglades Construction Project. If superior technology becomes available in the future which can be implemented to more effectively meet the intent and purposes of this section, the District is authorized to pursue that alternative through permit modification to the department. The department may issue or modify a permit provided that the alternative is demonstrated to be superior at achieving the restoration goals of the Everglades Construction Project considering:*
>
> *a. Levels of load reduction;*
> *b. Levels of discharge concentration reduction;*
> *c. Water quantity, distribution, and timing for the Everglades Protection Area;*
> *d. Compliance with water quality standards;*
> *e. Compatibility of treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area;*
> *f. Cost-effectiveness; and*
> *g. The schedule for implementation.*

In addition, the Everglades Forever Act contains the following guidance:

> *Implement solutions while minimizing impacts on South Florida jobs, including agricultural, tourism, and natural resource related, all of which contribute to a robust regional economy*

<u>3.1.4 Integration with CERP</u>

Federal and State statutes mandate that the implementation of CERP be integrated with other water resource projects (ss. 373.206, 373.1501, F.S., WRDA 2000), including the long-term water quality measures mandated by the Everglades Forever Act. Hence, the scope and timing of CERP projects need to be considered when evaluating long-term water quality solutions.

3.1.5 The Federal Clean Water Act

The Federal Clean Water Act contains guidelines for evaluating alternative projects that discharge fill or dredge materials into waters of the United States. As appropriate, these criteria will be considered on a qualitative basis by the District in consultation with FDEP, the U.S. Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and other agencies as appropriate.

3.1.6 Other Considerations

As part of the Supplemental Technology Standard of Comparison (STSOC)**,** evaluation criteria were developed based on the above considerations of the EFA and other relevant criteria, including scale-up uncertainty, operational flexibility, management of side streams, and sensitivity to extreme conditions (PEER Consultants, P.C./Brown and Caldwell, 1998). The results of applying these evaluation criteria to the 1979-88 STA-2 flows and loads will be carried over for use in this evaluation (modified as appropriate to the alternative being evaluated). The compatibility of treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area, including the potential toxicity criterion of the STSOC, will be evaluated separately by the FDEP.

3.2 Evaluation Criteria

Over the last decade there have been at least three separate evaluations of alternative treatment systems for the Everglades, each conducted for different objectives (Brown and Caldwell, 1993, PEER Consultants, P.C./Brown and Caldwell, 1996; PEER Consultants, P.C./Brown and Caldwell, 1998). In general, the evaluation criteria have covered technical, environmental, and economic factors, and have ranged in number from 10 to 24. Based on the above statutory guidance and other considerations, evaluation criteria are proposed for use in the present evaluation covering the categories of **Technical Performance, Environmental Factors, Economic Considerations and Integration with CERP**. The following sections describe these evaluation criteria and provide examples for their use. To aid this process, a multi-criteria decision making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the “optimal solution” would differ based on changes in the relative weights. More information on this process is provided in Section 5.

3.2.1 Technical Performance Evaluation Criteria

Technical Performance Evaluation Criteria Nos. 1-2: Level of phosphorus reduction.

The purpose of this evaluation criterion is to determine the level of phosphorus reduction for the alternative. Two aspects of phosphorus reduction will be evaluated: load and concentration. The data to be used for this evaluation will be results from simulations to be conducted during the feasibility studies, using the Dynamic Model for Stormwater Treatment Areas (DMSTA) (Walker and Kadlec, 2001). DMSTA simulates the flows and phosphorus removal within water quality treatment facilities (see Section 4.1). The calculation will compare the average annual phosphorus load and concentration derived for the 1965-95 baseline period with the average annual load and concentration for the alternative being evaluated.

Example:

1965-1995 baseline period average annual phosphorus levels for Basin X: 12.5 metric tons/yr and 65 ppb
Alternative 1 average annual phosphorus load: 2.9 metric tons/yr and 15 ppb
Level of Phosphorus Load Reduction = 12.5 – 2.9 = **9.6 metric tons/yr (76.9%)**
Hence, the score for this criterion is 76.9%
Level of Phosphorus Concentration Reduction = 65 – 15 = **50 ppb (76.9%)**
Hence, the score for this criterion is 15 ppb

Technical Performance Evaluation Criterion No. 3: Implementation schedule.

The purpose of this evaluation criterion is to compare alternatives based on the length of time required to design, construct, acquire land, and achieve full treatment capability, including any treatment start-up and stabilization. For alternatives with basin-scale public works as a component, schedule information obtained from the research teams regarding the time required for full-scale implementation of the technology will be used as an evaluation factor for this criterion. For alternatives with no basin-scale public works as a component, best professional judgement will be used. The value used for comparing the alternatives will be the duration in years required to produce a stable treatment system, assuming start of design on January 1, 2003, and the final completion date.

Example:

Basin X, Alternative 1 proposes chemical treatment. According to the narrative in the final report for this technology (HSA, page 157), the duration from finalizing process design criteria through permitting, land acquisition, construction, full-scale start-up and troubleshooting of constructed facility is reported to be

3.5 Years
Final completion date: June 1, 2006

If funding and land acquisition can be completed prior to June 2003, this alternative could be implemented prior to the December 2006 deadline.

Hence, the score for this criterion is 3.5 years

Technical Performance Evaluation Criterion No. 4: Operational Flexibility.

The purpose of this evaluation criterion is to assess the potential for the alternative to add operational flexibility to the South Florida hydraulic conveyance system and the Everglades Water Conservation Areas, while still meeting treatment objectives. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998):

> Factors such as peak flow attenuation, available storage capacity, effect on green space and wildlife habitat will be qualitatively assessed for each technology under this concept. The demonstration project research team shall present a short summary discussion documenting the ability of the supplemental technology to affect the factors listed above.

For alternatives with a public works component, the data used in this evaluation will come from the research demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, if the STSOC is incomplete, best professional judgement. Scores for this evaluation criterion will be assigned based on the following guidelines:

- 7-10 the alternative adds operational flexibility
- 4-6 the alternative has no influence on operational flexibility
- 1-3 the alternative reduces operational flexibility

Example:

Basin X, Alternative 1 proposes chemical treatment. Narrative on operational flexibility is provided in the final report for chemical treatment (HSA, p. 157-158). Operational flexibility is provided by the flow equalization basin component of this alternative, which allows attenuation of peak flows and storage of water during extreme rainfall events. It is reported that this feature allows this technology to consistently produce an acceptable effluent water quality.

Hence, the score for this criterion is 7.

Technical Performance Evaluation Criterion No. 5: Resiliency to fire, flood, drought and hurricane.

The purpose of this evaluation criterion is to assess the resiliency of a treatment system to fire, flood, drought and hurricane by determining the ability of the technology to re-establish design effluent conditions following such events. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998). Information to be provided by the demonstration project reports includes:

- Description of effect of fire, flood, drought and hurricane on the treatment facilities
- Time to re-establish design effluent conditions following such events
- Cost to re-establish design effluent conditions following such events

For alternatives with a public works component, the data used in this evaluation will come from the demonstration project reports for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, if the STSOC is incomplete, best professional judgement. Scores for this evaluation criterion will be assigned based on the following guidelines:

6-10 the alternative should generally be resilient to extreme conditions
1-5 the alternative should generally have a lack of resiliency to extreme conditions

Example:

Basin X, Alternative 1 proposes chemical treatment. Narrative on resiliency to fire, flood, drought and hurricane is provided in the final report for chemical treatment (HSA, page 158). While on-site fire, flooding and extreme weather (tornado) could have short-term impacts to the operation of the treatment plant itself, this alternative should generally be resilient to extreme conditions.

Hence, the score for this criterion would be 8.

<u>Technical Performance Evaluation Criterion No. 6: Assessment of full-scale construction and operation.</u>

The purpose of this evaluation criterion is to assess the potential for the alternative to succeed in full-scale construction and operation. This concept was developed for the STSOC as described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998), and is adopted for use in this evaluation methodology. The history and confidence level for the scale-up of a technology will be qualitatively assessed. Some of the parameters used to evaluate this concept are history of previous applications, differences between the Everglades Construction Project (ECP) and the previous applications, history of success or failure, assumptions made during the scale-up design, constructability and factors considered to require additional study. In addition, an assessment will be made of the uncertainty for construction and operations parameters (e.g., harvesting, sludge disposal/reuse) that may have a significant effect on cost.

For alternatives with a public works component, the data used in this evaluation will be based on the results of the research demonstration project presented pursuant to the STSOC standards for the individual treatment technology, modified as appropriate to the scale of the alternative. For alternatives with no public works component or if the STSOC is incomplete, best professional judgement will be used. Scores for this evaluation criterion will be assigned based on the following guidelines:

7-10 the alternative has been successfully constructed and operated at the proposed scale;
4-6 the alternative has not been successfully constructed and operated at the proposed scale, but no scale-up problems are anticipated
1-3 the alternative has not been successfully constructed and operated at the proposed scale, and scale-up problems are anticipated

Example:

Basin X, Alternative 1 proposes chemical treatment. According to the final report on chemical treatment, this technology has been successfully constructed and operated at large scale (two facilities are more than 500 MGD). In an initial review, this alternative would receive a score of "+". However, the alternative of chemical treatment followed by a post-treatment polishing marsh has never been demonstrated at the proposed scale, and until compatibility with receiving waters has been defined and tested, there is no way to assess scale-up. Hence, because of the remaining uncertainties, ***the score for this criterion is 7.***

<u>Technical Performance Evaluation Criterion No. 7: Management of side streams.</u>

The purpose of this evaluation criterion is to assess the level of effort required to manage side streams of each alternative. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998):

> The level of effort required to manage side streams is dependent upon various factors such as volume of side streams, type of side stream (sludge, residual solids, harvested vegetation) and method of disposal. This concept is considered an ancillary issue and will be evaluated qualitatively. The demonstration project research team shall list the annual volume of the side streams generated (including seepage losses) and their characteristics. The team shall also list likely, worst case, and best case disposal and reuse options for the side streams.

For alternatives with a public works component, the data used in this evaluation will come from the demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, if the STSOC is incomplete, best professional judgement. Scores for this evaluation criterion will be assigned based on the following guidelines:

7-10 there should be a net benefit from management of the side streams
4-6 the alternative requires no management of side streams
1-3 the alternative requires extensive effort and/or cost for management of the side streams, or there is potentially a net adverse impact associated with management of the side streams to indicate

Example:

Basin X, Alternative 1 proposes chemical treatment. In the narrative provided in the final report for chemical treatment (HSA, pages 158-159), land application is identified as the most cost-effective method for management of residuals. Because of the volume of residuals generated by this alternative, management of the residuals would require extensive effort and cost; ***hence, the score for this criterion is 2.***

3.2.2 Environmental Evaluation Criteria

Environmental Evaluation Criterion No. 1: Level of reduction in non-phosphorus parameters.

The purpose of this evaluation criterion is to determine the level of reduction in non-phosphorus parameters for the alternative, and compliance with existing water quality standards. For alternatives with a basin-scale public works component, the data used in this evaluation will come from the demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment). For alternatives with no basin-scale public works component, the data used in this evaluation will be based on best professional judgement. Scores for this evaluation criterion will be assigned based on the following guidelines:

7-10	the alternative produces a net improvement over the baseline conditions
4-6	the alternative produces similar water quality as the baseline conditions
1-3	the alternative is worse than the baseline conditions

Example:

Basin X, Alternative 1 - Chemical Treatment – High Rate Sedimentation. According to the final report for the demonstration research project for this technology (HSA, page 157), a few parameters are improved, a small number are similar, and, with a post-treatment polishing cell, there should be no adverse impacts.

Hence, the score for this criterion is 7.

Environmental Evaluation Criterion No. 2: Federal Clean Water Act guidelines.

The purpose of this evaluation factor is to assess each alternative based on a collection of guidelines provided by the Federal Clean Water Act. Section 401 (b) contains guidelines for evaluating alternative projects that discharge fill or dredge materials into waters of the United States (see Table 4). Table 4 will be refined and filled out by FDEP, District and EPA staff based on best professional judgement; an associated score will be established for each alternative.

TABLE 4. POTENTIAL IMPACTS OF PROJECT ALTERNATIVES*

Scoring:

X = significant potential adverse impact BLANK = unknown or unsure
0 = no known impacts + = potential positive impact

______ physical loss of substrate and habitat it provides
______ elevation of suspended particulates/turbidity
______ changes in water quality
______ changes in water level fluctuation
______ changes in salinity gradients
______ impairment or destruction of habitat or continued existence of threatened/endangered species
______ activity incompatible with Endangered Species Act (Sec. 7 denial)
______ impacts to components of the aquatic food web
______ impairment of reproduction and/or feeding or aquatic species
______ impacts to mammals associated with aquatic ecosystems
______ impacts to fish associated with aquatic ecosystems
______ impacts to birds associated with aquatic ecosystems
______ impacts to reptiles associated with aquatic ecosystems
______ impacts to amphibians associated with aquatic ecosystems
______ impacts to special aquatic sites (marine or estuarine sanctuaries or refuges)
______ impact to or elimination of wetlands habitat
______ impact to or elimination of vegetated shallows
______ impact to or elimination of riffle and pool complexes
______ impacts on quantity and/or quality of municipal and private water supplies
______ impact on the sustainability of recreational and commercial fisheries
______ impact on water-related recreation
______ impact on aesthetic qualities
______ impacts on educational qualities
______impacts on historical qualities
______ impacts on recreational qualities
______ impacts on scientific qualities
______ potential for impacts based on results of chemical, biological, and physical testing of water
______ potential for impacts based on results of chemical, biological, and physical testing of sediments
______ potential for impacts on benthos
______ potential for impacts on nearby waters based on elutriate testing
______ existing degree of stress based on biological community structure (s = stressed)
______ potential increase or relocation of contaminants
______ potential impacts on downstream flows
______ potential impact on hydrologic circulation and current patterns
______ potential adverse cumulative impacts
______ potential adverse secondary impacts

Will project violate toxic effluent standards? YES _____ NO _____
Do one or more reasonable practicable project alternatives that accomplish project goals with less adverse environmental impact exist? YES _____ NO _____

* Based on Clean Water Act Sec. 404(b)(1) guidelines

3.2.3 Economic Evaluation Criteria

Economic Evaluation Criteria Nos. 1-3: Costs.

The purpose of this evaluation criterion is to determine the **costs and related cost-effectiveness** of each alternative. Three aspects will be evaluated for each alternative: public costs, private costs and unit costs for phosphorus removal. The total cost estimate for each alternative shall include capital (design and engineering, equipment, land acquisition, construction and civil work), associated program management costs, and operation and maintenance costs, and will be reported as a 50-year present worth. As a measure of cost-effectiveness, the unit cost of phosphorus removal shall be calculated as the total costs divided by the total kilograms of phosphorus removed.

Example:

Basin X, Alternative 1 consists of source controls (private works) and a basin-scale treatment facility.
50-yr present worth of private cost =
$15 million (capital) + $15 million (O&M) = **$30 million**
Hence, the score for this criterion is $30 million
50-yr present worth of public cost =
$35 million (capital) + $35 million (O&M) = **$70 million**
Hence, the score for this criterion is $70 million
50-yr present worth of total cost =
$30 million + $70 million = **$100 million**
Unit cost of phosphorus removal = $100.0 million / 10.0 metric tons/yr for 50 years = **$200/kg**
Hence, the score for this criterion is $200/kg

Economic Evaluation Criterion No. 4: Impact on South Florida jobs.

The purpose of this criterion is to compare alternatives based on the potential impact on South Florida jobs, including agricultural, tourism, and natural resource-related jobs, all of which contribute to a robust regional economy. At least two previous analyses have been conducted to evaluate the potential economic impact of Everglades restoration programs:

1. *Twenty Year Evaluation: Economic Impacts from Implementing the Marjory Stoneman Douglas Everglades Restoration Act and the United States versus SFWMD Settlement Agreement*, Hazen and Sawyer, 1993.

2. *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* by U.S. Army Corps of Engineers and South Florida Water Management District.

Relevant information will be obtained from these documents to evaluate alternatives for this criterion.

Scores for this evaluation criterion will be assigned based on the following guidelines:

- 7-10 the alternative should have a positive impact on South Florida jobs
- 4-6 the alternative should have minimal impact on South Florida jobs
- 1-3 the alternative should have a negative impact on South Florida jobs

Example:

Basin X, Alternative 1 proposes the purchase of 500 acres of land that presently support a tree nursery that employees 15 workers. The land will be used for a basin-scale chemical treatment facility that will require the hiring of 75 workers during the 3 years of construction and 15 employees once the facility is operational. ***Hence, the score for this criterion is 8.***

3.2.4 Integration with CERP Evaluation Criteria

CERP Evaluation Criteria Nos. 1-3.

The purpose of these evaluation criteria is to compare alternatives based on the characteristics of the CERP project(s) planned for that basin. For basins with no CERP project, these factors will not be included in the evaluation. For basins with a CERP project, three aspects will be evaluated:

1. **Cost impact** - the cost impact, i.e., savings versus additional cost, (local, state and federal) that may result by integrating the long-term water quality treatment facilities with the CERP implementation schedule;

2. **Additional time to implement** - the length of time, in years, after the December 31, 2006, EFA mandate that the alternative is operational; and

3. **Water quantity, distribution, and timing** for the Everglades Protection Area, as compared to the proposed CERP project in the basin, if applicable. For integrated projects, the score will be set to 10, and for alternatives that are not integrated, the score will be based on similarity to the flows from the proposed CERP projects.

Example for a basin with a CERP project scheduled to be operational 12/2010:

Alternative 1 implements the long-term water quality solution independent from CERP (i.e., **not integrated**):

1. Since the projects are being implemented independently, there are no potential cost savings. ***Hence, the score for this criterion is $0.***
2. Since the projects are being implemented independently, there is no additional time to implement the integrated project. *Hence, the score for this criterion is 0 years.*
3. The alternative does not address water quantity, distribution, and timing for the Everglades Protection Area. *Hence, the score for this criterion is 5.*

Alternative 2 integrates the long-term solution with the CERP project:

1. The estimated cost savings to integrate the long-term water quality project with the CERP project is $75 million
   Hence, the score for this criterion is $75 million.
2. The integrated alternative will be operational in December 2010, or 4 years after the December 31, 2006 mandate of the Everglades Forever Act.
   Hence, the score for this criterion is 4 years.
3. The alternative does address water quantity, distribution, and timing for the Everglades Protection Area, consistent with CERP.
   Hence, the score for this criterion is 10.

3.2.5 Summary of Evaluation Criteria.

A summary of the evaluation criteria is presented in Table 5. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. More information on this process is provided in Section 5.

Table 5. Summary of Evaluation Criteria

Evaluation Criteria	Unit	Source of Data
Technical Performance Criteria		
Level of phosphorus load reduction	%	BSFS
Level of phosphorus concentration reduction	ppb	BSFS
Implementation schedule	years	BSFS
Operational flexibility, including adaptive Management	1 (worst) to 10 (best)	STSOC
Resiliency to extreme conditions	1 (worst) to 10 (best)	STSOC
Assessment of full-scale construction and operation	1 (high uncertainty) to 10 (high confidence)	STSOC
Management of side streams	1 (high effort) 10 (positive benefits)	STSOC
Environmental Criteria		
Level of reduction in non-phosphorus parameters (includes compliance with water quality standards)	1 (worst) to 10 (best)	STSOC
Clean Water Act guidelines	1 (worst) to 10 (best)	Consultation with other agencies
Economic Criteria		
Private Cost	$	BSFS
Public Cost	$	BSFS
Cost-effectiveness	$/kg	BSFS
Impacts on South Florida jobs, including agricultural, tourism, and natural resource related	1 (worst) to 10 (best)	BSFS
CERP Integration Criteria		
Cost savings for integration with CERP project	$	BSFS
Additional time to implement	years	BSFS
Water quantity, timing and distribution	1 (worst) to 10 (best)	BSFS

Abbreviations: BSFS – Basin-Specific Feasibility Studies
STSOC – Supplemental Technology Standard of Comparison

3.3 Key Uncertainties and Proposals for Addressing Them

A tremendous amount of research, data analyses, rulemaking, planning and basin-specific evaluations must be completed in a short time to develop integrated water quality plans and long-term permit applications by December 31, 2003. In order to meet the ambitious time frames mandated in the EFA, the District will be required to make recommendations for the long-term solutions based on incomplete science, engineering and regulatory information, which carries associated environmental and economic risks. The evaluation methodology needs to recognize and deal with regulatory, scientific, engineering and other uncertainties. In general, there are two types of uncertainties: (1) lack of knowledge surrounding a critical evaluation criterion or parameter; and (2) natural variability of the "true" values of the critical criterion or parameter. Each area requires a distinct approach for addressing the uncertainty. Addressing a lack of knowledge generally requires defining a reasonable range of probable values, while addressing natural variability generally requires formulating an estimate of the underlying probability distribution of the "true" values of the critical criterion or parameter, and subsequently simulating a range of outcomes, usually by using a Monte Carlo technique. In addition, the use of best professional judgment and well-documented assumptions will be necessary during the conduct of the Basin-Specific Feasibility Studies whenever uncertainties are encountered.

The key uncertainties in the information base for the long-term decisions, many of which are outside the control of the District, are summarized below, along with the proposed approach for dealing with the specific uncertainty.

3.3.1 Lack of Basin-specific Total Phosphorus Discharge Target

This design parameter is of paramount importance. Differences between an assumed target and the target identified after completion of the regulatory process could result in significant differences in the recommended long-term water quality solution. The three primary features comprising the basin discharge target are described below.

A. **Lack of a Class III numeric phosphorus criterion for the EPA.** The Florida Department of Environmental Protection (FDEP) is set to initiate rulemaking this year, however, it may be the end of 2003 before a standard is actually adopted. By that time, alternative long-term water quality solutions need to be identified, evaluated and selected; in addition permit applications need to be submitted to FDEP by December 2003. A default criterion of 10 ppb is to be set if FDEP fails to adopt the standard by December 2003. At the present time, it is not unreasonable to expect that the criterion will be close to 10 ppb.

B. **Lack of a methodology to be used to determine compliance with the Class III numeric phosphorus criterion for the EPA.** The methodology will define measurement locations, frequency of sampling, and temporal averaging period (e.g., daily, monthly or annual), and whether concentration, loads or both will apply. The FDEP is set to initiate rulemaking this year, however, it may be the end of 2003 before a compliance methodology is actually adopted. The Act provided the following guidance:

> *Compliance with the phosphorus criterion shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations recognized from the research to be reasonably representative of receiving waters in the Everglades Protection Area, and so located so as to assure that the Everglades Protection Area is not altered so as to cause an imbalance in natural populations of aquatic flora and fauna and to assure a net improvement in the areas already impacted.*

C. **Lack of a defined relationship between waters entering the Everglades and the resulting water quality in the EPA.** This relationship is critical because it relates the end-of-pipe concentration (design discharge target) to the interior marsh concentration and potential compliance locations.

Options. The basin-specific discharge target is critically important in determining the appropriate water quality treatment solution. Options for addressing the uncertainty include

1. Setting a range of phosphorus discharge targets for each basin, e.g., from 10 ppb to 20 ppb.
2. Determining the best possible water quality performance for each alternative.
3. A combination of 1 and 2 above, i.e., determining the best possible water quality performance for each alternative, or 10 ppb, whichever is higher.

Proposed Approach for addressing these three uncertainties: Option 3 is proposed. For ECP basins with STAs of a fixed area, the DMSTA model will be used calculate the long-term average annual phosphorus concentration for each alternative. For non-ECP basins, iterations of the DMSTA will be run (varying the effective treatment area) to determine the minimum area required to produce the lowest long-term average annual phosphorus concentration for each alternative, or 10 ppb, whichever is higher.

<u>3.3.2 Uncertain effectiveness and cost of phosphorus source controls in upstream basins</u>

The optimal solution for ensuing compliance with long-term water quality goals will likely be a mixture of private and public works. Each basin will likely have a unique ratio of private/public obligation. The District is implementing a Regulatory Action Strategy in those basins that do not include an STA. Because limited information on BMP effectiveness and costs exists at this time, best professional judgement will be used in the evaluation.

Proposed approach: While insufficient information exists to project with great certainty the performance and cost of source controls, a range of characteristics may be utilized in this evaluation (e.g., between 0% and 25% load reduction) for each basin, based on existing and proposed land use and best professional judgement.

3.3.3 Uncertain effectiveness and cost of phosphorus treatment performance of basin-scale treatment solutions

The District is presently examining the technical efficacy, costs, and implementation schedules of advanced phosphorus reduction treatment alternatives. Fundamental demonstration research results are presented in the final reports for each technology:

Chemical Treatment – High Rate Sedimentation: August 2000
Chemical Treatment – Microfiltration: October 2000
SAV: March 2002 (DMSTA model calibration expected to be complete Summer 2001)
PSTA: September 2001 (DMSTA model calibration expected to be complete Summer 2001)

Proposed Approach: For the biological-based "green" technologies, an idealized treatment area is proposed, consisting of an emergent marsh on the front end followed by an SAV/PSTA system on the back end. This component will utilize a composite set of parameters for the DMSTA model based on the best professional judgement of District staff and the DMSTA model developers. During the evaluation, a sensitivity analysis will be conducted to estimate the impact of varying the critical DMSTA parameter values on the resulting phosphorus performance.

For the chemical treatment options, the demonstration project final reports will be used. The final report of the Chemical Treatment demonstration research project discusses a post-treatment polishing marsh as part of the treatment process, yet no design parameters are presented. For the purpose of this evaluation, it is proposed that a post-treatment polishing marsh be sized with a hydraulic residence time of 1-3 days.

3.3.4 Uncertain modifications to the flows and phosphorus loads resulting from CERP components, along with implementation schedules

Projects of the Comprehensive Everglades Restoration Plan (CERP) are planned for many of the basins that discharge into the EPA; these projects will significantly influence the current flows and phosphorus loads to the EPA.

Options:

1. Flows could be estimated from the 2010 CERP Case from the SFWMM simulation model. Inflows to the CERP project could be used to generate a

time series of inflow phosphorus data using the same algorithms as was used in the Baseline Data Sets (Goforth and Piccone 2001). This inflow time series could be input to a DMSTA model to create a time series of phosphorus outflows from the CERP project.

2. The DMSTA model could be used to estimate the outflow volumes and phosphorus time series from the CERP project. The 1965-95 baseline data set will then be modified based on these simulated flows and phosphorus data, and a revised baseline data set will be used in evaluating alternatives that include CERP projects.

Proposed Approach: It is proposed to Option 2. In addition, the Act requires consideration of water quantity, distribution, and timing for the Everglades Protection Area, factors that are explicitly addressed by CERP, and will not be an independent part of this evaluation.

3.3.5 The amount of land available for treatment facilities in each basin is unknown

Average land prices (+/- 30%) obtained from the District's Real Estate Division in April 2001 are provided in Table 6 for use in evaluating alternatives, however, no discussions have taken place with landowners regarding availability of land for treatment facilities.

Proposed Approach: During the conduct of the feasibility studies, work will proceed under the assumption that sufficient land will be available for the treatment works. Actual land availability will be finalized during subsequent steps in the decision-making and design process.

3.3.6 "Compatibility" with receiving waters is undefined

As stated above, the 1994 Everglades Forever Act requires consideration of the compatibility of the treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area. Despite several years of investigation, the FDEP has been unable to develop a regulatory definition for "compatibility". During the demonstration research projects for the STSOC, the potential toxicity of advanced treatment technologies was investigated as a measure of compatibility, and these STSOC results will be incorporated. Three options were considered for addressing this uncertainty in these feasibility studies:

1. FDEP will continue seeking a definition of "compatibility", and if that definition is available during the feasibility studies, then it will be used. If, however, the definition is not formalized in time, then the FDEP will make this determination subsequent to the feasibility studies.
2. Focus on those water quality parameters that do not have a State standard and are either added to the water during the treatment process or are significantly altered during the treatment process. For alternatives with a public works component, the data used in this evaluation could come from the demonstration project for each individual treatment technology (if monitored).

For alternatives with no basin-scale public works component, the data used in this evaluation will be based on best professional judgement.

3. The estimated phosphorus concentration for the alternative could be used as a surrogate for compatibility with receiving waters by use of the following (or modified as appropriate) relationship:

Surrogate for Compatibility with Receiving Waters

Long-term Flow-weighted Mean Discharge Concentration of Phosphorus (ppb)	Score
<10	5
10 – 15	4
15 – 20	3
20 - 25	2
25 – 30	1
>30	0

Proposed Approach: Option 1 above.

3.3.7 Lack of revised water quality standards for parameters other than phosphorus applicable to the EPA and classification of EAA canals

The EFA directs the District and FDEP to complete any additional research to evaluate existing water quality standards applicable to the Everglades Protection Area and classification of EAA canals. To date, it is not certain if the EFA mandated evaluation will result in any revisions to State water quality standards, which may, in turn, have an influence on the long-term water quality solutions. Waiting until the results of the evaluation are presented by FDEP may jeopardize the District's ability to complete the feasibility studies and subsequent permit applications by December 31, 2003.

Proposed approach: It is proposed that the evaluation will use the assumption that existing water quality standards are applicable to the Everglades Protection Area. In conjunction, the results of the STSOC chemical analyses will be used for this evaluation. Should FDEP present its findings prior to the completion of the feasibility studies, adjustments would be made as appropriate.

3.3.8 Allowance for bypass of treatment facilities

The design of the ECP incorporated a 0% bypass of the 10-year base period of record (1979-88) storm flows. In order to cover a wider range of possibilities, the STSOC used a range of 0%, 10% and 20% bypass.

Proposed Approach: The EFA mandates that all discharges to the EPA should achieve compliance with long-term water quality standards. For the purpose of evaluating alternatives, it is proposed that the treatment facilities will be sized to capture all of the simulated 1965-95 flows with no hydraulic bypass. A 0% bypass condition should also ensure that existing flood protection in each basin is not compromised by any alternative.

3.3.9 Lack of funding for long-term solutions, including resolution of the public/private mix of funding

The ultimate determination of long-term basin-specific water quality solutions will likely be based on available private and public funding mechanisms.

Proposed Approach: Proceed with evaluation of alternatives as a fact-gathering exercise. The final combination of water quality measures will be basin-specific and eventually decided by policy makers (Legislature, local governments, etc.) based on the results of the feasibility studies and consideration of funding. However, the current lack of funding for the long-term solutions should not delay the investigation of basin-specific feasibility studies.

Table 6. Preliminary Basin-specific Cost Estimates for Land

BASIN	Unit Cost $/acre	Contingency	Comments
S-5A	$6,200	30%	
S-6	$10,500	30%	Land adjacent to STA-2 are owned by District for EAA Reservoir
S-7	$2,800	30%	Land adjacent to STA-3/4 are owned by District for EAA Reservoir
S-8	$2,800	30%	Land adjacent to STA-3/4 are owned by District for EAA Reservoir
C-139 (including the Annex)	$3,000	30%	Land between STA-5 and STA-6 is owned by District for EAA Reservoir
C-51 West	$15,000	50%	Only available land is north of C-51 Canal
North Springs Improvement District	$20,000	50%	
North New River Canal	$20,000	50%	
C-11 West	$20,000	50%	
Feeder Canal	$1,200	50%	
L-28	$1,200	50%	
ACME Basin B	$21,500	30%	May need to be reviewed based on sale of Section 34

3.4 Proposed Methodology

Based on the above statutory guidance and key uncertainties, a methodology is proposed to evaluate alternative combinations of private works and public works to achieve compliance with the long-term water quality standards for the Everglades Protection Area. The major steps in this methodology are summarized below. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. More information on this process is provided in Section 5.

Step 1. Finalize the basin-specific combinations of source control and basin-level treatment that define each alternative. These alternatives will be finalized after workshops with stakeholders in each basin.

Step 2. Modify the baseline data set daily time series to reflect the assumed phosphorus reduction (0-100%) and flow reduction (0-100%) of the basin source controls.

Step 3. Modify the baseline data set daily time series to account for the CERP project, if present in the alternative.

Step 4. If a chemical treatment facility is part of the alternative, the sizes of the flow equalization basin, chemical treatment modules (e.g., 50 MGD units) and post-treatment polishing marsh will be estimated by use of the Chemical Treatment Spreadsheet discussed in Section 4.2.

Step 5. Set up the DMSTA model (see description in Section 4.1)

a. If the land area is a variable, iteration may be required to identify the area required to achieve the lowest phosphorus discharge concentration, or 10 ppb, whichever is higher.
b. If the land area is fixed (e.g., in the ECP basins), then DMSTA will be run to estimate the resulting discharge phosphorus concentration.
c. A sensitivity analysis will be conducted on the DMSTA results. For example, the key parameters of DMSTA could be varied from –50% to +100%, and a range of phosphorus concentration results could be generated and compared.

Once the DMSTA modeling is completed, the following evaluations will be conducted.

Step 6. Technical Performance Evaluation Criteria Nos. 1-2: The level of phosphorus load and concentration reductions will be calculated as the difference between the baseline value and the alternative value for the 31-year average annual load.

Step 7. Technical Performance Evaluation Criterion No. 3 - An estimate of the implementation schedule for the alternative will be developed, including land acquisition, design, construction and sufficient operation to achieve stable performance.

Step 8. The following Technical Performance Evaluation criteria will be evaluated based on information provided by the STSOC:

Evaluation Criterion No. 4 - Assessment of full-scale construction and operations.
Evaluation Criterion No. 5 - Resiliency to fire, flood, drought and hurricane.
Evaluation Criterion No. 6 – Operational flexibility.
Evaluation Criterion No. 7 - Level of effort required to manage side streams.

Step 9. Environmental Evaluation Criterion No. 1 - The level of reduction in non-phosphorus parameters will be calculated including compliance with water quality standards.

Step 10. Economic Evaluation Criteria Nos. 1-3 - Cost. Using the BMP guidelines provided by the District, an estimate of the phosphorus reduction efficacy and costs (capital and operation and maintenance costs) for BMPs in the basin shall be estimated. A conceptual-level layout of the basin-scale facility, if included, will be generated. 50-year present worth estimates of capital, operation and maintenance costs will be developed, consistent with the method used in the STSOC guidelines. Using the load reduction estimates developed above, the unit cost for phosphorus removal will also be calculated.

Step 11. Economic Evaluation Criterion No. 4 – Impacts on South Florida jobs. Two prior economic analyses have been prepared:

1. *Twenty Year Evaluation: Economic Impacts from Implementing the Marjory Stoneman Douglas Everglades Restoration Act and the United States versus SFWMD Settlement Agreement* (Hazen and Sawyer, 1993).
2. *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement.* (U.S. Army Corps of Engineers and South Florida Water Management District, 1999).

In addition, District staff is currently conducting an interim analysis of the economic impacts of CERP. It is proposed that these serve as a basis for projecting impacts on South Florida jobs.

Step 12. CERP Integration Evaluation Criterion Nos. 1-3. A comparison will be made of costs and time frame for integrating the water quality solution project with the CERP project in the subject basin.

Step 13. Environmental Evaluation Criterion No. 2: Clean Water Act Guidelines

Part 1. District staff to meet with FDEP and EPA (and possibly Corps, USFWS, etc.) and refine the list of potential impacts in Table 4 to eliminate irrelevant factors, eliminate redundancy with other evaluation criteria, and add other site-specific factors.

Part 2. After completion of Steps 1-12, the same group will meet to collectively fill out the list of potential impacts.

Step 14. Compatibility with Receiving Waters (to be evaluated in conjunction with FDEP staff).

Step 15. Summarize the results of the evaluation in a draft report to be presented at a public workshop.

Step 16. Finalize the results of the evaluation in a final report to be presented to the District Governing Board.

4.0 ANALYTICAL TOOLS

4.1 DMSTA Description

Dynamic Model for Stormwater Treatment Areas (DMSTA) was developed by Drs. Bill Walker and Bob Kadlec for the U.S. Department of the Interior. The STAs were sized using a steady-state model calibrated to soil & water-column phosphorus data from Water Conservation Area 2A. The DMSTA is an enhanced spreadsheet-based model that provides a framework for integrating experimental & field-scale monitoring data and can be used in developing designs for the next generation of treatment areas. The details of the model development and use can be found at the web site: http://wwwalker.net/dmsta/index.htm.

4.1.1 Factors Considered by DMSTA, but not by the Steady-State STA Design Model

Temporal Variations in Inflow Volume, Load, Rainfall, & ET
Hydraulic Compartments (Cells, Flow Distribution Levees)
Hydraulic Efficiency (Number of Stirred Tanks in Series)
Cell Aspect Ratio (Length:Width)
Water Level Regulation
Outflow Regulation (Discharge vs. Water Level)
Compartmentalization of Biological Communities
Dry-Out Frequency & Supplemental Water Needs
Bypass Frequency, Quantity, & Quality
Seepage Collection & Management

4.1.2 Input Data Requirements

Morphometry (Length, Width, Area, Cell Configuration)
Hydraulic Efficiency (Number of Stirred Tanks in Series)
Daily Time Series:
- Inflow & Outflow Volume
- Inflow & Outflow Concentration
- Mean Depth
- Rainfall
- Evapotranspiration

Descriptive Data:
- Seepage Rates
- Community Description
- P Storage (metadata: macrophytes, periphyton, soil)

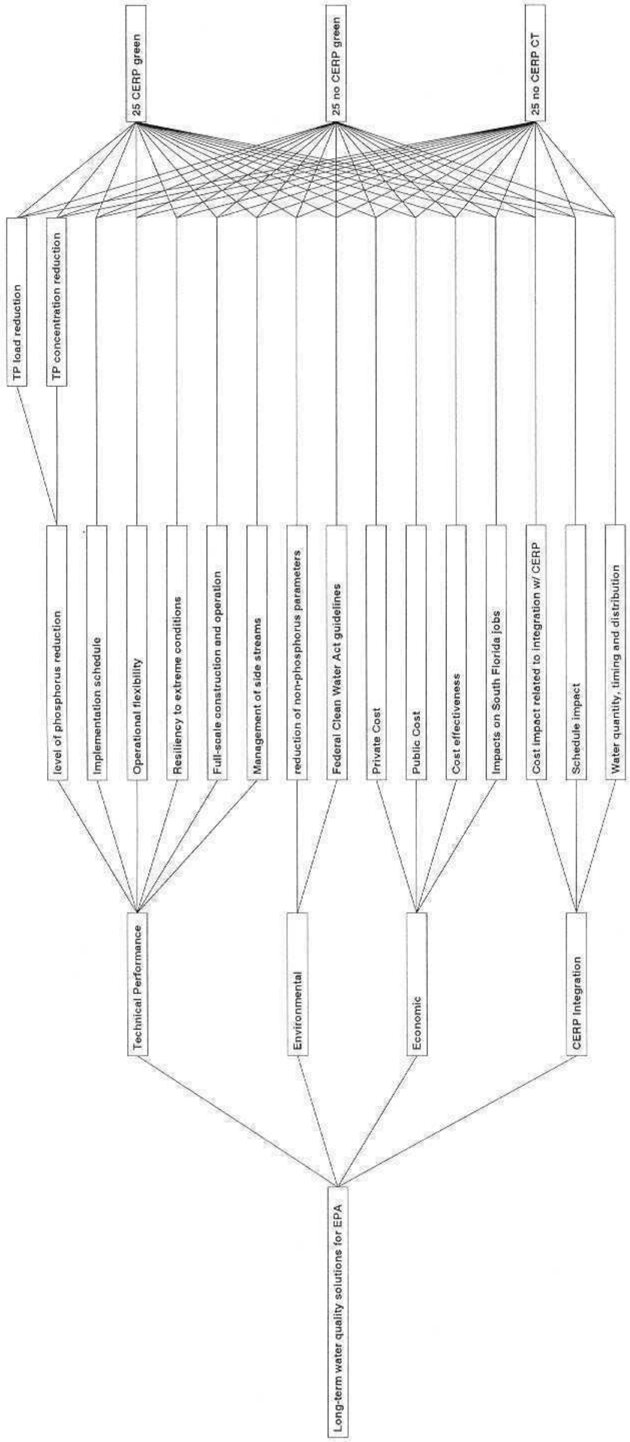
4.2 Chemical Treatment Facilities Spreadsheet

A spreadsheet tool was developed during the demonstration research project for chemical treatment. The spreadsheet accepts daily flow data and can be used to size flow equalization basins and chemical treatment components. With some modification, it could also be used to help size the post-treatment polishing marsh.

5.0 POST-EVALUATION DECISION MAKING PROCESS

The evaluation of alternative water quality improvement strategies described above is a fact-gathering activity, and by itself cannot determine or recommend an “optimal” combination of water quality treatment solutions. However, the results of the evaluation will give the Florida Legislature, the District Governing Board, and other stakeholders the critical technical information necessary to make the policy decisions needed determine the “optimal” combination of water quality treatment solutions. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the “optimal solution” would differ based on changes in the relative weights. An example of the decision hierarchy diagram associated with such a process is presented in Figure 2. It is proposed to use the software Criterium Decision Plus produced by Infoharvest, Inc. (1997). This software features the ability to handle multiple layers of criteria and subcriteria, offers multiple probability distribution functions to handle uncertainty, multiple options for scaling the values for each criterion, comprehensive sensitivity analyses, highly interactive graphics for use in consensus building, easy documentation of assumptions made and the reasons for intermediate decisions, and offers both the S.M.A.R.T. and AHP algorithms. Additional details are found on the website

http://www.Infoharvest.com


25 CERP green
25 no CERP green
25 no CERP CT
TP load reduction
TP concentration reduction
level of phosphorus reduction
Implementation schedule
Operational flexibility
Resiliency to extreme conditions
Full-scale construction and operation
Management of side streams
reduction of non-phosphorus parameters
Federal Clean Water Act guidelines
Private Cost
Public Cost
Cost effectiveness
Impacts on South Florida jobs
Cost impact related to integration w/ CERP
Schedule impact
Water quantity, timing and distribution
Technical Performance
Environmental
Economic
CERP Integration
Long-term water quality solutions for EPA

1

6.0 REFERENCES

Brown and Caldwell, Mock, Roos & Associates, Inc., and Applied Technology and Management, Inc. *Phase II Evaluation of Alternative Treatment Technologies.* 1993.

Goforth, Gary, Tracey Piccone. *Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-term Water Quality Goals for the Everglades.* South Florida Water Management District, Everglades Construction Project Division. 2001.

HSA Engineers & Scientists, Milian, Swain & Associates, and Lockhart AG Technologies. *Chemical Treatment Followed by Solids Separation Advanced Technology Demonstration Project*. 2000.

Hazen and Sawyer. *Twenty Year Evaluation: Economic Impacts from Implementing the Marjory Stoneman Douglas Everglades Restoration Act and the United States versus SFWMD Settlement Agreement.* 1993.

PEER Consultants, P.C., Brown and Caldwell. *Desktop Evaluation of Treatment Technology Alternatives.* 1996.

PEER Consultants, P.C., Brown and Caldwell. *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects*. 1998.

U.S. Army Corps of Engineers Jacksonville District and South Florida Water Management District. *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement.* 1999.

Walker, William W., Jr., Ph.D., R. Kadlec. *Dynamic Model for Stormwater Treatment Areas*. 8 Aug. 2001 http://wwwalker.net/dmsta/index.htm.

ATTACHMENT 1

STSOC GUIDELINES FOR COST ESTIMATES

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
1	**Capital costs**					
1.1.1	Equipment		$ -		$ -	
1.1.2	Residuals management		$ -		$ -	
1.2	Freight		$ -		$ -	
1.3	Installation		$ -		$ -	
1.4	Instrumentation		$ -		$ -	
1.5	Electrical controls					
1.5.1	Electrical controls					
1.5.2	Electrical power distribution	$/mile	$ 80,000			
1.6	Civil Work- water control structures					
1.6.1	84" culvert open	per structure	$ 20,000			
1.6.2	84" culvert with gate	per structure	$ 35,000			
1.6.3	With gates	per structure	$ 300,000		$ -	
1.6.4	Without gates	per structure	$ 150,000		$ -	
1.7.1	Canals (digging - no blasting)					
1.7.1.1	Canals- Deep excavation	$/cubic yard	$ 3.50		$ -	
1.7.1.2	Canals- Shallow excavation	$/cubic yard	$ 2.50		$ -	
1.7.2	Canals (including blasting)					
1.7.2.1	Canals- Deep excavation	$/cubic yard	$ 4.50		$ -	
1.7.2.2	Canals- Shallow excavation	$/cubic yard	$ 3.50		$ -	
1.8.1	Levees (no blasting)					
1.8.1.1	Internal- 7' (4.5' SWD)	$/mile	$ 390,000		$ -	
1.8.1.3	External- 8' (4.5' SWD)	$/mile	$ 485,000			
1.8.1.4	External- 9' (4.5' SWD)	$/mile	$ 562,000		$ -	
1.8.1.5	External-10' (4.5' SWD)	$/mile	$ 703,000			

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
1.9	Pumping stations					
1.9.1.1	0-40 cfs	$/cfs	$ 7,600		$ -	
1.9.1.2	41-60 cfs	$/cfs	$ 9,500		$ -	
1.9.1.3	60-500 cfs	$/cfs	$ 9,900		$ -	
1.9.1.4	500-3,000 cfs	$/cfs	$ 7,500		$ -	
1.10	Interior land preparation					
1.10.1	Disking	$/acre	$ 60		$ -	
1.11	Land					
1.11.1	Equalization basin	$acre	$ 4,655			
1.11.2	Treatment	$/acre	$ 4,655			
1.11.3	Polishing, administrative, etc.	$/acre	$ 4,655			
1.11.4	Residuals management	$/acre	$ 4,655			
1.12	6" gravel access roads (12 ft wide road)	$/linear ft	$ 150		$ -	
1.13	Engineering and Design costs	Lump sum				
1.14	Contingencies	Lump sum				
TOTAL CAPITAL COSTS						
2	**OPERATING COSTS (per year)**					
2.1	Labor				$ -	
2.1.1	Engine operator/Maintenance mechanic	each	$ 50,000			
2.1.2	Lead operator	each	$ 60,000			
2.2.1.1	Mechanical maintenance (lubrication, spare parts, etc.)- 500- 3,000 cfs pumps	per unit	$ 23,000		$ -	
2.2.1.2	Mechanical maintenance- 0-500 cfs pumps	per unit	$ 10,000			
2.2.2	Maintenance (water control structures)	each	$ 12,000		$ -	
2.2.3	Maintenance (building)	per unit	$ 12,000		$ -	
2.2.4	Maintenance- Levees	$/mile	$ 1,530		$ -	
2.2.5	Maintenance (vegetation control)	$/acre	$ 22		$ -	
2.2.6					$ -	
2.2.7					$ -	
2.2.8	Maintenance- Sludge treatment		$ -		$ -	
2.3	Chemicals					

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
2.3.1	Aluminum sulfate	Dry ton	$ 150		$ -	
2.3.2	PAC	lb	$ 0.20		$ -	
2.3.3	Ferric chloride	Dry ton	$ 180		$ -	
2.3.4	Ferric sulfate	lb	$ 0.40		$ -	
2.3.5	Lime		$ -		$ -	
2.3.6	Polymer	Tons	$ 4,000		$ -	
2.3.7	Others		$ -		$ -	
2.4	Solids disposal	Tons	$ 50		$ -	
2.5	Energy		$ -		$ -	
2.5.1	Electricity	KW/hr	$ 0.08			
2.5.2	Fuel consumption	acre-feet	$ 0.50			0.55 gal/acre-foot @ $0.9/gallon
TOTAL OPERATING COSTS:						
3	**Salvage/Demolition/Replacement costs**					
3.1	Demolition costs				$ -	
3.2	Restoration of levees	$/yard	$ 3		$ -	
3.3	Restoration of FEBs		$ -		$ -	
3.4	Clearing and grubbing		$ -		$ -	
	Light folliage	$/acre	$ 300			
	Forest/heavy brushes	$/acre	$ 1,500			
3.5	Replacement items		$ -		$ -	
TOTAL DEMOLITION/REPLACEMENT COSTS						
4	**Lump sump/ Contingency items**					
4.1	Telemetry					Project specific
4.1.1	Pump stations	$/unit	$ 50,000			
4.1.2	Water control structure	$unit	$ 25,000			
4.2	FPL improvements	Lump sum	$ -		$ -	
4.3	Administrative facilities	Lump sum	$ -		$ -	
4.4	Sampling and monitoring	Lump sum	$			
TOTAL LUMP SUM ITEMS					$ -	